Practice: 527 - Karst Sinkhole Treatment

Scenario: #2 - Reverse Filter, CY

Scenario Description:

Closing a cone-shaped sinkhole with stone, gravel and soil from offsite sources in order to maintain existing hydrology. The area around a sinkhole is unstable and slippage or subsidence may occur. Sinkholes present safety hazards to people, equipment and/or livestock. Sinkholes are direct conduits to groundwater, nutrient or chemical laden runoff that enters a sinkhole will pollute groundwater. Sinkholes have routinely been used as waste disposal sites. The sinkhole area and depth is easy to measure to estimate the volume of work to be done. Associated practices: Critical Area Planting (342), Fence (382), Vertical Drain (630), Obstruction Removal (500) & Filter Strips (393) Diversion (362).

Before Situation:

An open sinkhole exists in an agricultural setting. Open sinkhole poses a risk to people, equipment, livestock, & wildlife. The sinkhole has been used as a waste disposal site and is full of solid waste and debris. Polluted runoff flows into the open sinkhole untreated. Typical Sinkhole treated is cone-shaped, with a 30' Diameter opening & 8' depth.

After Situation:

Solid waste, if present, is addressed under associated practice Obstruction Removal (500). Organic debris and soil are excavated and utilized or disposed on-site. The sinkhole closure consists of locating the throat, plugging the throat, and placing layers of graded aggregate. A few boulders are placed to bridge the throat, followed by layers of progressively smaller material from rip-rap to sand. Porous material is used to filter runoff and maintain the hydrology of the karst system. Geotextile spans the opening to separate material and distribute loads. Native soil is spread and graded to blend with original ground. A buffer may be established around the sinkhole through associated practice Critical area planting (342).

Scenario Feature Measure: CY of sinkhole

Scenario Unit: Cubic Yard

Scenario Typical Size: 75

Scenario Cost: $9,985.28 **Scenario Cost/Unit:** $133.14

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price ($/unit)	Quantity	Cost
Equipment/Installation						
Geotextile, woven	42	Woven Geotextile Fabric. Includes materials, equipment and labor	Square Yard	$2.37	220	$521.40
Excavation, Common Earth, side cast, small equipment	48	Bulk excavation and side casting of common earth with hydraulic excavator with less than 1 CY capacity. Includes equipment and labor.	Cubic yard	$2.36	75	$177.00
Earthfill, Dumped and Spread	51	Earthfill, dumped and spread without compaction effort, includes equipment and labor	Cubic yard	$3.60	110	$396.00
Dozer, 80 HP	929	Track mounted Dozer with horsepower range of 60 to 90. Equipment and power unit costs. Labor not included.	Hour	$76.63	16	$1,226.08
Hydraulic Excavator, 2 CY	932	Track mounted hydraulic excavator with bucket capacity range of 1.5 to 2.5 CY. Equipment and power unit costs. Labor not included.	Hour	$217.41	16	$3,478.56
Labor						
General Labor	231	Labor performed using basic tools such as power tool, shovels, and other tools that do not require extensive training. Ex. pipe layer, herder, concrete placement, materials spreader, flagger, etc.	Hour	$20.77	16	$332.32
Equipment Operators, Heavy	233	Includes: Cranes, Hydraulic Excavators >=50 HP, Dozers, Paving Machines, Rock Trenchers, Trenchers >=12", Dump Trucks, Ag Equipment >=150 HP, Scrapers, Water Wagons.	Hour	$28.85	32	$923.20
Materials						
Rock Riprap, graded, angular, material and shipping	1200	Graded Rock Riprap for all gradation ranges. Includes materials and delivery only.	Ton	$30.83	18	$554.94
Aggregate, Gravel, Graded	46	Gravel, includes materials, equipment and labor to transport and place. Includes washed and unwashed gravel.	Cubic yard	$31.83	38	$1,209.54
Mobilization						

Mobilization

Mobilization, medium equipment	1139	Equipment with 70-150 HP or typical weights between 14,000 and 30,000 pounds.	Each	$291.56	2	$583.12
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Practice: 527 - Karst Sinkhole Treatment

Scenario: #3 - Reverse Filter, SF

Scenario Description:

Installing a sinkhole protection cap on a sinkhole with a vertical opening. The area around a sinkhole may be unstable and slippage or subsidence may occur. Sinkholes present fall hazards to people and livestock. Sinkholes are direct conduits to groundwater. Nutrient or chemical laden runoff may flow directly into sinkholes polluting groundwater. Sinkholes are routinely used for waste pits by landowners. The sinkhole surface area is easily determined, but the depth is not defined making a volume determination difficult, therefore use the surface area as the payment unit. This option to solve situation includes removing any debris, removing unconsolidated soil down to bedrock, installing geotextile, large rock and progressively smaller rock, wrap with geotextile to make a reverse filter and capping with impervious material if site is not a low area. Naturally low areas will be finished to allow perculation without causing fines to move out with associated practice, Vertical Drain.

Associated Practices: Critical Area Planting (342), Fence (382), Vertical Drain (630), Obstruction Removal (500) & Filter Strips (393) may be associated practices for this scenario.

Before Situation:

Open sinkhole poses threat to people, livestock, & wildlife. Absence of buffer allows nutrients and chemicals to flow into the open sinkhole untreated. Trash & Debris have accumulated in the sinkhole from years of use as a waste pit. Typical Sinkhole treated is 30' Dia & 8' depth

After Situation:

Debris removed and properly disposed of off site. The 30' diameter by 8' deep sinkhole was then excavated and layers of geotextile and stone placed to establish a reverse filter and then topped with a protective cap of soil to resolve the safety issue for people, livestock, & wildlife. SItes with sinkholes in low areas will need a vertical drain too allow drainage and planned as a seperate practice.

Scenario Feature Measure: Surface area of sinkhole

Scenario Unit: Square Foot

Scenario Typical Size: 706

Scenario Cost: $6,641.02 **Scenario Cost/Unit:** $9.41

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price ($/unit)	Quantity	Cost
Equipment/Installation						
Geotextile, woven	42	Woven Geotextile Fabric. Includes materials, equipment and labor	Square Yard	$2.37	220	$521.40
Earthfill, Dumped and Spread	51	Earthfill, dumped and spread without compaction effort, includes equipment and labor	Cubic yard	$3.60	70	$252.00
Hydraulic Excavator, 1 CY	931	Track mounted hydraulic excavator with bucket capacity range of 0.8 to 1.5 CY. Equipment and power unit costs. Labor not included.	Hour	$130.06	8	$1,040.48
Hydraulic Excavator, 1 CY	931	Track mounted hydraulic excavator with bucket capacity range of 0.8 to 1.5 CY. Equipment and power unit costs. Labor not included.	Hour	$130.06	8	$1,040.48
Labor						
General Labor	231	Labor performed using basic tools such as power tool, shovels, and other tools that do not require extensive training. Ex. pipe layer, herder, concrete placement, materials spreader, flagger, etc.	Hour	$20.77	10	$207.70
Equipment Operators, Heavy	233	Includes: Cranes, Hydraulic Excavators >=50 HP, Dozers, Paving Machines, Rock Trenchers, Trenchers >=12", Dump Trucks, Ag Equipment >=150 HP, Scrapers, Water Wagons.	Hour	$28.85	8	$230.80
Materials						
Rock Riprap, graded, angular, material and shipping	1200	Graded Rock Riprap for all gradation ranges. Includes materials and delivery only.	Ton	$30.83	36	$1,109.88
Aggregate, Gravel, Graded	46	Gravel, includes materials, equipment and labor to transport and place. Includes washed and unwashed gravel.	Cubic yard	$31.83	52	$1,655.16
Mobilization						
Mobilization, medium equipment	1139	Equipment with 70-150 HP or typical weights between 14,000 and 30,000 pounds.	Each	$291.56	2	$583.12